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Trip planners used in public transportation.

Case study on the city of Timișoara

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Abstract

Having easy access to information became vital for people living in the 21st century but most of all for passengers and commuters. As a response to this demand, public transport operators along with municipalities and software engineers started creating a variety of programs called trip planners that have the main purpose to inform passengers about: arriving time, routes, prices, distances, points of interest, location, connections with other means of transport, number of transfers and other information. This paper analyzes the importance of trip planners for public transportation operators and for passengers who use public transportation. The authors present trip planners used today in different cities from different countries and information provided to passengers. There are two types of information: basic information, vital for passengers, that all trip planners should provide and complex information which can be extracted in the near future from the new design trip planners. The paper shows how a trip planner can be built, based on a certain algorithm, the inputs of data that are required and the generated outputs. The trip planner presented in the paper is designed for the city of Timișoara (Romania) and links the city's transportation ways such as: air, rail and road with all the other transportation modes.

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1. Introduction

In the 21st century, passengers, especially commuters want to travel fast, safe, comfortable and cheap having easy access to information. “Taking into consideration the passengers demand that they want to travel fast having a high comfort during the journey, highlights that price is not the first criteria in choosing the transportation mode.” (K. Rigas, 2009) “In his book (F. Ghionea, 2010) says that there should be a philological level for transfers from one vehicle to another that should not be crossed. In his example for citizens living in big cities the total number of transfers during a trip should not exceed one and for commuters should not be higher than three.” The conclusions to this fact is that commuters are more tolerant than citizens living in big cities and public transportation operators have to reduce the number of transfers during one trip in order to avoid losing clients and attract new ones. Trip planners represent the solution for all the above demands. A well design trip planner: attracts more costumers for the public transportation operator, inform the passengers regarding possible: faster, safer, more comfortable and cheaper alternatives of travelling and also protects the environment by: reducing the use of private cars that lead to a lower CO₂ emissions, reduce the use of paper maps and time tables in stations. The paper is structured into five parts as fallow: first part is a short introduction, part two presents existing trip planners and other platforms that help determine citizens’ needs for travelling, in the third part represents our proposal of a complex trip planner, in the fourth part are presented trip planners that are used nowadays in Timișoara city and the last part consists in conclusions and further research.

2. Trip planners and other platforms used nowadays around the globe

Multimodal travel is by its very nature more complex. That is where multimodal journey planners come in. These online tools can help travelers plan a journey from A to B detailing the different types of transport to take, times and even fares.” (<http://ec.europa.eu/transport/its/multimodal-planners/examples-of-existing-national-journey-planners>) This chapter will present some trip planners that are used in different countries and the concept of “supernetwork” (T. A. Arentze and H. J. P. Timmermans, 2004) and “Albatross” (T. A. Arentze and H. J. P. Timmermans, Aug. 2004) simulation program that are developed in Holland.

2.1. Existing trip planners around the world

Comparing three trip planners from three cities: Eindhoven, Lisbon and Timișoara from three countries: Holland Portugal and Romania highlighted that each of them provides vital information but also have a lack of information. In Holland there is only one trip planner called “9292” (www.9292.nl) connecting all means of transportation: train, metro, tram bus, “vaporetto” (P. Ștefănescu, 2012) and giving information regarding each private transport operator across Holland. It is a very complex trip planner giving information: regarding starting time, total time, number of transfers, price per each fare and total price for entire trip. One of the issues is that it does not offer any detail regarding the CO₂ emissions and does not provide any map. In Lisbon there is one similar trip planner called “transporlis” (www.transporlis.sapo.pt) that offers information regarding: time tables, price per fare, information related to transport operators, also provides a map and the CO₂ emissions. The main issue is that it does not connect all the cities in Portugal just Lisbon with the peripheral region. Timișoara has a trip planner that is called “tpltm” (www.tpltm.ro) that offers few information and it is concentrated only on Timișoara’s public transportation, more information are presented in chapter 4. This trip planner has to suffer many modifications, in chapter 3 it will be presented an alternative way for solving this issue. Besides Nederland that implemented “9292” (www.9292.nl) trip planner for the entire country, there are other countries from Europe that have designed such platforms, here are some example extracted from the European Commission Mobility & Transport site: Austria with SCOTTY & VERKEHRSPILLOT, Belgium with NMBS-SNCB & INFOTEC, The Czech Republic with IDOS, Denmark with BilRejseplanen, Estonia with Peatus.ee, Finland with Journey.fi, Germany with DELFI & Reiseauskunft, Luxemburg with Mobilitétszentral, Poland with SITkol, Portugal with TransPOR, Sweden with RESROBOT, U.K. with Transport Direct, Norway with Rutebok.no and Switzerland with SBB Online Fahrplan. As a conclusion there are countries that have two trip planners and other countries that have none.

2.2. Supernetworks

This is a new concept that is studied at the Technical University in Eindhoven in the Urban Planning department and it is applied for some Dutch regions including Eindhoven city. According to T. Arentze et al. “The activity based models predict which activities will be conducted. This concept refers to simulations of different routes for citizens that are living in big cities.”(T. A. Arentze and H. J. P. Timmermans, 2004) A new concept of multistate network (MSN) is introduced by the same researcher. T Arentze describes MSN as follow: “In general, a path through an MSN describes a multimodal, multi-activity tour and the associated aggregate generalized costs represent the aggregate disutility caused by travel times, waiting times, search times and activity times included in the path.”(T. A. Arentze and H. J. P. Timmermans, 2004) In addition J. Zhang in his paper discusses about multimodal transport network model and says: “The multimodal network can be viewed from many aspects. From a physical point of view, it can be classified into road, rail, water and air. On the other hand, from a functional point of view, it can be classified into private modes (e.g. foot, bike and car) and public modes (e.g. bus, train, tram and metro). Private networks offer continues service at any time associated with both physical nodes and physical links. On the other hand, public transport networks offer discrete services according to time tables where by physical nodes (e.g. stops, stations) are visible while physical links are usually invisible. Therefore, the functional view is suitable for modelling the multimodal transport network.”(J. Zhang et al. 2011) “In his paper F. Liao et al. brings the concept of “supernetwork”(T. A. Arentze and H. J. P. Timmermans, 2004) at another level by introducing time-space constraints and activity-travel time profiles.” (F. Liao et al., work in progress) Another paper by F Liao et al. adds to the concept of the “supernetwork the park and ride concept.”(F. Liao et. al., 2011) This new perspective and concept of “supernetwork”(T. A. Arentze and H. J. P. Timmermans, 2004) helps developing more complex trip planners based on the people needs and habits in means of transportation.

2.3. Albatross

In his paper T. Arentze et al. describes Albatross as follow: „This activity-based model of activity-travel behaviour is derived from theories of choice heuristics that consumers apply when making decisions in complex environments. The model, one of the most comprehensive of its kind, predicts which activities are conducted when, where, for how long, with whom, and the transport mode involved. In addition, various situational, temporal, spatial, spatial-temporal and institutional constraints are incorporated in the model.”(T. A. Arentze and H. J. P. Timmermans, Aug. 2004) The model was designed in C++. The data regarding people behaviour was gathered by conducting a survey on people living in the target area on 2000 household days that means that each person had to say what was his/hers schedule of activities for two consecutive days. This method was applied at the beginning, now each person that is involved in the programme carries with him/her a GPS device that can track and locate during the entire day the person position and at the end of the day each person has to upload the data on the internet server. This model represents an important step for creating complex trip planners because it determines how often people need to travel, what types of vehicles they chose, at what hour do they start their journey and what places do they visit.

3. Our proposal for a complex trip planner TransPlus

Living in a big city brings the need to use public transportation to get from one point to another. That is when we turned to the transport companies' websites to see what means of transport to take, and in what order. But in every situation, we were confronted with poor solutions or lengthy operations for a simple purpose: getting from A to B. The main issues we encountered were:

- Slow and/or limited route planning interface: only one route was shown, without the guarantee that it is the best one, or even the criteria on which the choice has been made
- The need to know the exact station names. That is a clear inconvenient for people new to the city or just passing by for a few days
- No graphical representation of the route. That way, the guide becomes confusing
- Poor or no support for mobile platforms, users being unable to plan or change the route on the go.

After dealing with these problems, we have decided to implement our own solution that addresses and tries to solve them, and bring a few more facilities for the best possible user experience. That solution is TransPlus. It is a new way of travelling through a city by public transport. It has two main components: the desktop component – used to input public transport for a city and the Android-based component – used to help plan the best trip for the user's current need.

3.1. Input data for TransPlus

The imputed data for TransPlus consists of: all the names for each station, district and the GPS coordinate, all the routes along with the map of the city, all the distances between each consecutive station and the total distance on each route, type of public vehicle and the CO₂ emissions, price per fare, commercial speed of each vehicle, arriving time for each station and total time needed for each route, rush hours, points of interest, and all the transfer hubs.

3.2. Algorithm for TransPlus

The basic algorithm used for a trip planner is “Dijkstra's algorithm, conceived by Dutch computer scientist Edsger Dijkstra in 1956 and published in 1959, is a graph search algorithm that solves the single-source shortest path problem for a graph with non-negative edge path costs, producing a shortest path tree. This algorithm is often used in routing and as a subroutine in other graph algorithms.” (http://en.wikipedia.org/wiki/Dijkstra's_algorithm) That is why we decided to use Dijkstra's algorithm to create TransPlus. The efficiency of our trip planner comes from the algorithm adapted for this kind of search, which takes into account the user's preferences for the current route, making sure that the best result is being displayed given the input parameters. The versatility of TransPlus comes from the possibility to cover any city, with different transport options, and, in the future, to be able to link the cities and to plan country-wide trips, with the same efficiency and precision.

3.3. Output data

With this trip planner we can retrieve information such as: total time spent on the road by each passenger, total number of transfers from one vehicle to another, total waiting minutes, total cost of the trip, CO₂ emissions, alternative routes and information for passengers related to other facilities such as free internet in the vehicle the possibility to carry your bicycle with you in the bus. Also the passenger can chose from chip route to short route as showed in Fig.1. After the options have been set, the application will use an adapted shortest-path algorithm, using all the given criteria, to find the best route and present it to the user. It will do so in two ways: by text instructions, and via a graphical implementation Fig.2 Along with those features, more will come in order for the application to be the ultimate route planner for every traveller in a city: the possibility to choose the street / district for starting and destination points, in case station names are not known, the current location will be shown in real time on the map, for a better orientation, cities will be interlinked, so that the user will be able to plan more complex trips, the map will have the Save feature, so the computed route will be stored as image file for future reference.

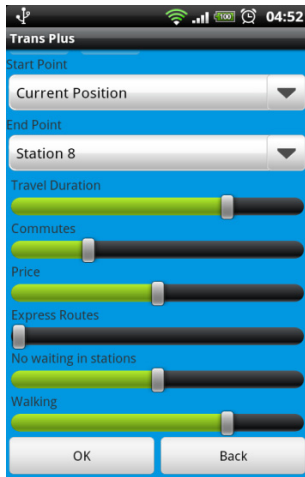


Fig. 1. Route constraints

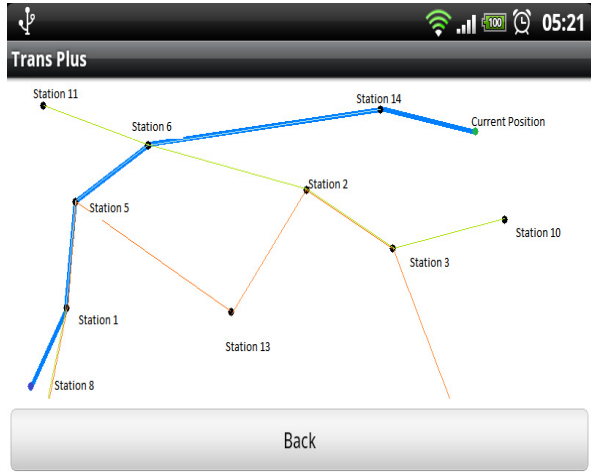
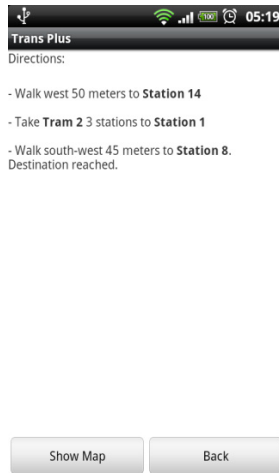


Fig. 2. Route details

4. Existing trip planners in Timișoara city

In Timișoara city there are two planners one called “TPLTM”(www.tpltm.ro) that was created with E.U. funds and the second one is an application for mobile phones called “Public transport Timișoara.” (<https://play.google.com/store/apps/details?id=ro.mihai.tpt&hl=en>) TPLTM is a platform that offers information for passengers regarding the three modes of transport that are present in Timișoara: bus, trolleybus and tram, general information regarding the cost for fare, data related to stations and routes, locations where the passengers can buy tickets. The main issue of this planner is that if passengers do not know the exact name of each station it is very hard to establish the route. Also it does not connect all the transport means such as bicycles, “park and ride” (Vision 2030 Public Conference, 2010), trains and planes and does not provide alternative routes. The planner does not specify: exact arriving time for each public transportation vehicle, length of each route and total cost of the fare. It does not provide information regarding the CO₂ emissions per each fare. As a conclusion, it is very poor in giving information and useless for commuters and tourist who do not know the names for all the stations and the public transportation routes. The other planner that consists in a mobile application provides only information related to the arriving time of each public transportation vehicle for each station. The good things of this application is that it offers an accurate time of ± 1 minute, has a friendly and easy to use interface and it is free. The main issues are: it provides only the arriving times in each station, it does not give you total length of the route, the trip total time, price per fare and it does not work offline. Having a complex trip planner for a city such as Timișoara is a necessity. Our goal as presented in chapter three is to create a trip planner TransPlus that has a friendly interface to be easy to use by any passenger, to offer as many information as possible from basic to complex, to work online and offline, to be sustainable and protect the environment and to be as cheap as possible. Basic information is: time of arrival in station, total time, number of transfers, total cost for the trip and route length. Complex information is: CO₂ emissions for each trip, type of vehicle, alternative routes (the fastest route, the cheapest route), to link other means of transport such as: train, plane, boat, car and bike, to link the city with other cities in Romania and to link Romania with other countries. By providing information related to the CO₂ emissions it can sensitize the citizens to choose the green way for traveling and also being electronic and providing an electronic map, it will reduce the use of paper maps. In our opinion TransPlus is better than TPLTM and Public Transport Timișoara because it offers better information, new information and accurate one. The possibility to use it on line and offline is one of the most important features. Another important fact is that it can be access from a personal computer by accessing the website or it can be installed on your mobile phone as an application. Users can send feedback to the developer by touching the feedback button. The starting interface of TransPlus along with the four main buttons: route planner where the user can set his route, options where the interface and the colors can be changed, help/about that is a guide and the

feedback button are presented in Fig.3 In Fig.4 is presented the interface where the user can select date and time constraints along with starting and ending point of the journey.

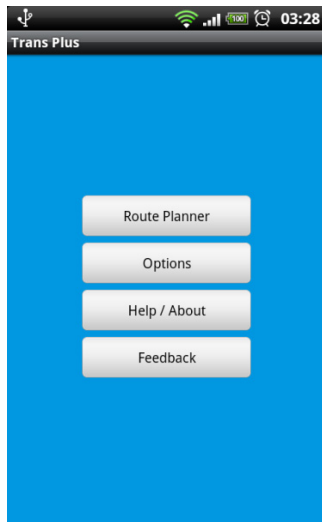


Fig. 3. TransPlus starting interface

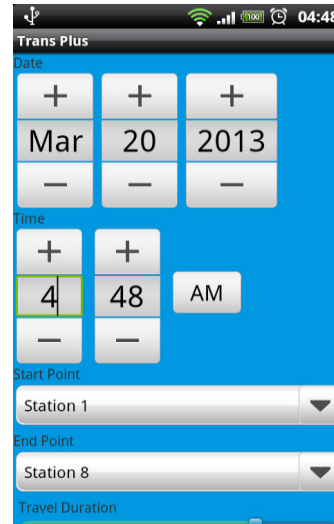


Fig. 4. TransPlus date, time and starting/ending point

5. Conclusions and further research

One of the important links in public transportation system is represented by trip planners. The more complex they are the more benefits they bring: for transport operator by attracting more customers and increasing the income of the company, for municipality by attracting more tourists for passengers providing easy access to information in a short time from each location and also it resolves many environmental issues such as CO₂ emissions, dust, traffic congestions, infrastructure maintenance by reducing them due to the fact that many citizens use the public transportation to reach their desired destination. Other important steps have been made in the public transportation area such as: implementing the “ticketing system”(P. Ștefănescu, 2012), designing trip planners and mobile applications to inform passengers, developing programs such as “Albatross”(T. A. Arentze and H. J. P. Timmermans, Aug. 2004) and “supernetworks”(T. A. Arentze and H. J. P. Timmermans, 2004) all of them leading to a “better door to door mobility.” (P. Ștefănescu, MVT 2012) If each country develops at least one trip planner it will be easier to link all the data and create one global trip planner. In the near future public transportation operators will design only one trip planner for entire public transportation network on globe, this will represent a huge step in public transportation. The pioneers in creating one trip planner for entire globe are: Google maps and “rome2rio” (www.rome2rio.com). Google maps does not offer all the information and do not link all means of transportation for the entire globe due to the fact that it does not have all the data from each city regarding: time table of public transportation vehicles, road infrastructure, alternative means of transportation and offers coverage just for some countries around the globe. Rome2rio is more complex trip planner than Google maps but still can be updated with information such as: total cost per fare, exact departing time for each transport way. The next step in public transportation is to have: a complex, easy to use, free, trip planner that connects all means of transport on the entire globe.

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